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Patent- og Varemærkestyrelsen
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19 November 2004

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PATENT- OG VAREMÆRKESTYRELSEN

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A PRESSURE RELIEF DEVICE FOR AN INFLATABLE TIRE

Technical field

The present invention relates to a pressure relief device for an inflatable tire, in particular a vehicular tire. The device is intended to release air from the tire when the pressure in the tire exceeds a certain threshold value or to prevent excess air from being forced into the tire during inflation thereof.

Background of the invention

Various pressure relief devices for inflatable tires have been proposed in the prior art. US patent No. 3,830,249 discloses a device in which a pressure relief ball is maintained in a seated position by a force applied by a compression spring until the air pressure within the tire exceeds a set pressure. When the set pressure has been exceeded, the pressure relief ball is unseated from the body, and surplus air escapes from the tire via the pressure relief device.

US patent No. 4,660,590 is concerned with an inflation pressure regulator with a substantially friction-free flexing seal arrangement within a housing of the regulator which bypasses the tire when the pressure within the tire reaches a predetermined level. A sealing section of a flexure member is normally urged into sealing contact with a seat surface owing to the force exerted against the flexure member by a spring/ring combination. When the tire has been inflated to the pressure rating of the regulator, the pressure in a fist chamber in the housing will exert sufficient force against the upper face of the flexure member to cause a flexing in a portion thereof and a consequential movement of the sealing section away from the seat surface, allowing air to escape via an exhaust aperture.

Summary of the invention

The pressure relief device of the invention generally comprises:

- a body having a chamber therein and defining a circumferential outer surface portion;
- an inflation valve arranged in the body; and
- an overpressure valve arranged in the body for releasing air when the air pressure in the chamber exceeds a predetermined pressure level.

It is an object of preferred embodiments of the present invention to provide a pressure relief device which can be mass produced with little variation in the threshold pressure. It is a further object of preferred embodiments of the invention to provide a compact device which causes reduced inertial imbalance of a tire to which the device is mounted, as compared to known devices. It is a further object of preferred embodiments of the invention to provide a pressure relief device which is resistant to wear and tear. It is a still further object of preferred embodiments of the invention to provide a device which allows for a variable threshold pressure level, or various embodiments of which may be manufactured with variable threshold pressures while maintaining low production costs.

Accordingly, the device of the present invention is characterised in that the overpressure valve comprises:
- at least one air conduit extending from said chamber through the body to said circumferential outer surface portion;
- a ring-shaped resilient member which is contractively fitted around the circumferential outer surface portion, so as to keep the air conduit in a normally closed state;
the properties and dimensions of the resilient member being such that it is stretched when the air pressure in the chamber exceeds the predetermined threshold pressure level, so as to provide an air passage from the conduit to an exterior environment.

It will be appreciated that the provision of a ring-shaped resilient member, the properties and dimensions of which define the predetermined pressure level, allows for easy variation of the predetermined pressure level, as the threshold pressure level may be changed by replacing the resilient member with another resilient member. If a user of the device of the invention does not wish to replace the resilient member with another one, he/she may alternatively exchange the entire device with another device which is provided with a resilient member corresponding to a pressure level according to the user's choice. As ring-shaped resilient members may be produced in large numbers with high manufacturing accuracy and yet at low costs, preferred embodiments of the invention offer a cheap, but efficient alternative to known devices.

Moreover, the physical dimensions of preferred embodiments of the device of the invention, in particular a longitudinal dimension thereof, i.e. a dimension which extends transversely to the circumference of a tire when the device is mounted on a valve of a tire, may be relative small, as there is no need for one or more longitudinally extending coil springs arranged to maintain a relief member in a seated position. This in turn causes reduced inertial imbalance of a tire to which the device is mounted, as compared to known devices.

Those dimensions and properties of the resilient member which define the threshold pressure level may for example include the elasticity of the material or composition from which the member is made, the distortion of the member, and the thickness of the material or composition of the member. The mutual positioning of the air conduit and the ring-shaped resilient member may also influence the threshold pressure level, and a width of the ring-shaped resilient member as well as a cross-sectional area of the air conduit may also influence the threshold pressure level.

It should be understood that the air conduit and the chamber may be constituted by the same, i.e. by one single cavity, bore or cut-out in the housing.

In order to protect the resilient member against dirt and physical impacts, the resilient member may be arranged in a reduced diameter section of the outer surface portion. The reduced diameter section may also serve to ensure that the resilient member is always mounted in its correct position or at least reduce the risk of mounting the resilient member in a wrong position. The air conduit preferably extends through the body in the reduced diameter section. Further protection of the resilient member and/or of a portion of the body may be obtained by covering at least a top portion of the body with a protective cover or cap. The protective cover or cap may also serve to protect the inflation valve in the body, which is accessible from the outside via a passage or opening in the body. Preferably, the cover is releasably connected to the body, so that it may be removed for inflation of the tire.

A bottom portion of the body preferably defines a cavity for receiving a valve of the tire centrally within the body, the cavity most preferably defining a threaded portion for screwing the device onto a threaded portion of a tire valve. A top portion of the body may be adapted to connect the inflation valve in the body to an inflation device, such as an air inflation nozzle. In order to ensure a short longitudinal extent of the device, the air conduit is preferably arranged radially displaced with respect to the cavity near the bottom portion.

As mentioned above, the predetermined pressure level, i.e. the threshold pressure level of the device, may be varied by exchanging the resilient member with another resilient member having different properties. However, the pressure level may also be varied by a pressure adjusting system for varying the predetermined threshold pressure level, for example means for varying a cross-sectional area of the air conduit and/or means for varying a distortion of the resilient member.

In order to notify a user when the predetermined threshold pressure level has been reached or exceeded during inflation of the tire, there may be provided means for emitting an acoustic signal or means for emitting an optical signal when the air pressure in the chamber

has reached or exceeds the predetermined pressure level. In one embodiment, the acoustic signal is generated as a whistling tone generated by excess air flowing past the resilient member. Once the excess air has escaped, excess air will no longer flow past the resilient member, and the whistling tone will stop. Alternatively, there may be provided electronic means, e.g. in the form of an electronic pressure sensor coupled to a light-emitting means or an electronically controlled sound source.

The invention further provides a kit comprising a plurality of pressure relief devices, wherein the devices define different predetermined pressure levels. Preferably, each device in the kit is easily identifiable by a user, so that each individual device in the kit may be associated with a particular pressure level. For example, the resilient member of each individual device of the kit may define a coloured outer surface portion, with the outer surface portions of the respective resilient members of the devices being coloured differently, and the kit may further comprise a list of colours and corresponding pressure levels. Alternatively or additionally, the predetermined threshold pressure level of each device of the kit may be indicated on a visible surface of the device.

In a further aspect there is provided a combination of a pressure relief device as disclosed herein and an inflatable tire. The pressure relief device may be permanently integrated with the tire, for example with a stem of the tire, or it may be releasably attached to the stem of the tire.

Brief description of the drawings

The invention will now be further described with reference to the drawings, in which:

Fig. 1 shows a first cross-section through a first embodiment of a device according to the invention;

Fig. 2 shows a second cross-section through the embodiment of Fig. 1;

Fig. 3 shows a top view of the embodiment of Figs. 1 and 2;

Fig. 4 shows a partial cross-section through the embodiment of Figs. 1-3 when mounted to an inflation valve of a tire;

Fig. 5 shows a second cross-section through the embodiment of Fig. 4;

Fig. 6 shows a top view of the embodiment of Figs. 4 and 5;

Fig. 7 shows a first cross-section through a second embodiment of a device according to the invention;

Fig. 8 shows a second cross-section through the embodiment of Fig. 7;

Fig. 9 shows a top view of the embodiment of Figs. 7 and 8;

Fig. 10 shows a partial cross-section through the embodiment of Figs. 7-9 when mounted to an inflation valve of a tire;

Fig. 11 shows a second cross-section through the embodiment of Fig. 10;

Fig. 12 shows a top view of the embodiment of Figs. 10 and 11.

Detailed description of the drawings

The pressure relief device 100 of Figs. 1-6 comprises a body 102, in an upper portion of which there is provided an inflation valve comprising a pin 104 for releasing a stem of a tire valve (not shown). An outer circumferential surface portion 106 of the upper portion of the body is threaded, so as to facilitate attachment of an air inflation device to the body. The pin 104 is slidingly mounted in a sleeve member 108 which is provided with outwardly extending protrusions 110 (see Fig. 3) which are squeeze-fitted into a passage 112 in the upper portion of the body. Gaps between an outer circumferential surface of the sleeve member 108 and an inner circumferential surface of the passage 112 define first flow passages 114. A bottom portion of the body defines a cavity 116 for receiving a valve 132 of a tire (see Figs. 4-6) centrally within the body. An insertion element 118 is fitted into the bottom portion of the body and held in place by a barbed portion 122. The insertion element defines a threaded portion 120 for attaching the pressure relief device to the tire valve 132. Between upper and outer surfaces of the insertion element 118 and an inner surface of the body there is provided a gap which defines a chamber 124, the chamber 124 communicating with the cavity 116 via a second flow passage 126. Air conduits 128 are provided in a wall of the body in the lower portion thereof, the air conduits being normally closed/sealed by a ring-shaped resilient member 130 which is tightly fitted around a circumferential outer surface portion of the body in a reduced diameter section thereof. As shown in Figs. 4 and 5, a cap 134 may be provided for protection the body and the valve system in the body.

The pressure relief device is operated as follows: the device is screwed onto an outer surface portion of a tire valve 132 by means of the threaded portion 120 of the insertion element 118, the tire valve 132 being thereby received in the cavity 116. An inflation device, such as an air hose nozzle, which is connected to a pressurized source, is then attached to the upper portion of the body 102, with a stem of the inflation device (not shown) contacting the pin 104. The pin 104 is thereby pressed downwards until a flange portion 105 thereof abuts a surface 103 (see Fig. 2) of the wall of the body 102. The lower end of the pin 104 thereby contacts the upper end of the valve stem (not shown) associated with the tire. Air flows from the pressurized source to the interior of the tire via the first and second flow passages 114 and 126. The air pressure in the cavity 116, chamber 124 and air conduit 128 will be essentially equal to the tire pressure. The pressure in the air conduit 128 exerts an outwardly directed force on the ring-shaped resilient member 130. When the pressure in the air conduit 128 and thus in the tire reaches a certain threshold level, the ring-shaped resilient member is stretched outwardly, whereby the air conduit 128 is placed in communication with the surrounding atmosphere. The threshold pressure level is determined by the properties, such as elasticity and distortion, of the ring-shaped resilient member.

Figs. 7-12 show a second embodiment of a pressure relief device 200 according to the invention, comprising a body 202, in an upper portion of which there is provided an inflation valve comprising a pin 204 for releasing a stem of a tire valve (not shown). An outer circumferential surface portion 206 of the upper portion of the body is threaded, so as to facilitate attachment of an air inflation device to the body. The pin 204 is slidingly mounted in a sleeve member 208 which is provided with outwardly extending protrusions 210 (see Fig. 9) which are squeeze-fitted into a passage 212 in the upper portion of the body. Gaps between an outer circumferential surface of the sleeve member 208 and an inner circumferential surface of the passage 212 define first flow passages 214. A bottom portion of the body defines a cavity 216 for receiving a valve 132 of a tire (see Figs. 4-6) centrally within the body. An inner circumferential surface of a lower portion of the body defines a threaded portion 220 for attaching the pressure relief device to the tire valve 132. Combined air conduits and chambers 228 provided in a wall of the body communicate with the cavity 216 via second flow passages 226. The air conduits 228 are normally closed/sealed by a ring-shaped resilient member 230 which is tightly fitted around a circumferential outer surface portion of the body in a reduced diameter section thereof. As shown in Figs. 10 and 11, a cap 234 may be provided for protection the body and the valve system in the body.

The pressure relief device is operated as follows: the device is screwed onto an outer surface portion of a tire valve 132 by means of the threaded portion 220, the tire valve 132 being thereby received in the cavity 216. An inflation device, such as an air hose nozzle, which is connected to a pressurized source, is then attached to the upper portion of the body 202,

with a stem of the inflation device (not shown) contacting the pin 204. The pin 204 is thereby pressed downwards until a flange portion 205 thereof abuts a surface 203 (see Fig. 8) of the wall of body 202. The lower end of the pin 204 thereby contacts the upper end of the valve stem (not shown) associated with the tire. Air flows from the pressurized source to the interior of the tire via the first and second flow passages 214 and 226. The air pressure in the cavity 216 and air conduit 228 will be essentially equal to the tire pressure. The pressure in the air conduit 228 exerts an outwardly directed force on the ring-shaped resilient member 230. When the pressure in the air conduit 228 and thus in the tire reaches a certain threshold level, the ring-shaped resilient member is stretched outwardly, whereby the air conduit 228 is placed in communication with the surrounding atmosphere. As in the first embodiment, the threshold pressure level is determined by the properties, such as elasticity and distortion, of the ring-shaped resilient member.

The body of any embodiment of the device according to the present invention may be moulded entirely from a plastics material or manufactured from any suitable metal alloy. Disposable embodiments are preferably manufactured from a plastics material, for example a material having a hardness which is low enough to ensure that the threaded portion 120 is damaged after a single or very few uses. This ensures that the device is only used once or few times, so that the resilient member 130 is not worn to such an extent that the threshold pressure is significantly influenced by wear on the resilient member.

CLAIMS

1. A pressure relief device for an inflatable tire, comprising:
- a body having a chamber therein and defining a circumferential outer surface portion;
- an inflation valve arranged in the body;
- an overpressure valve arranged in the body for releasing air when the air pressure in the chamber exceeds a predetermined pressure level;
characterised in that the overpressure valve comprises:
- at least one air conduit extending from said chamber through the body to said circumferential outer surface portion;
- a ring-shaped resilient member which is contractively fitted around the circumferential outer surface portion, so as to keep the air conduit in a normally closed state;
the properties and dimensions of the resilient member being such that it is stretched when the air pressure in the chamber exceeds the predetermined pressure level, so as to provide an air passage from the conduit to an exterior environment.

2. A device according to claim 1, wherein the resilient member is arranged in a reduced diameter section of the outer surface portion.

3. A device according to claim 1 or 2, wherein a bottom portion of the body defines a cavity for receiving a valve of the tire centrally within the body, and wherein a top portion of the body is adapted to be connected to an inflation device, the air conduit being arranged radially displaced with respect to said cavity near the bottom portion.

4. A device according to any of the preceding claims, further comprising a protective cover for covering at least the top portion of the body, the cover being releasably connected to the cover.

5. A device according to any of the preceding claims, further comprising a pressure adjusting system for varying the predetermined pressure level.

6. A device according to claim 5, wherein the pressure adjusting system comprises means for varying a cross-sectional area of the air conduit.

7. A device according to claim 5 or 6, wherein the pressure adjusting system comprises means for varying a distortion of the resilient member.

8. A device according to any of the preceding claims, further comprising means for emitting an acoustic signal when the air pressure in the chamber exceeds the predetermined pressure level.

9. A device according to any of the preceding claims, further comprising means for emitting an optical signal when the air pressure in the chamber exceeds the predetermined pressure level.

10. A kit comprising a plurality of pressure relief devices according to any of the preceding claims, wherein the devices define different predetermined pressure levels.

11. A kit according to claim 10, wherein each resilient member defines a coloured outer surface portion, and wherein the outer surface portions of the respective resilient members of the devices are coloured differently, the kit further comprising a list of colours and corresponding pressure levels.

12. A combination of a pressure relief device according to any of the preceding claims and an inflatable tire.

ABSTRACT

A pressure relief device (100;200) for an inflatable tire comprises a body (102;202) having a chamber (124;228) with an inflation valve arranged in the body. An overpressure valve in the body releases air when the air pressure in the chamber exceeds a predetermined threshold pressure level. The overpressure valve includes at least one air conduit (128;228) extending from the chamber through the body in order to provide a passage to a surrounding atmosphere. A ring-shaped resilient member (130;230) is contractively fitted around an outer surface portion of the body, so as to keep the air conduit in a normally closed state. The properties and dimensions of the resilient member are such that it is stretched when the air pressure in the chamber exceeds the predetermined pressure level, so as to provide an air passage from the conduit to the surrounding atmosphere. A plurality of pressure relief devices may be included in a kit, wherein the devices define different predetermined pressure levels.

(Fig. 1)

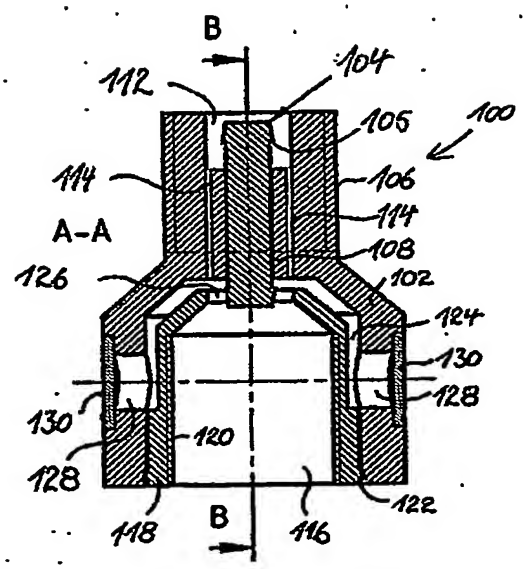

Fig. 1

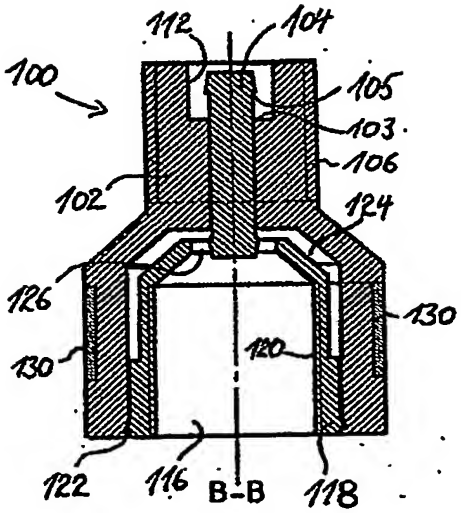

Fig. 2

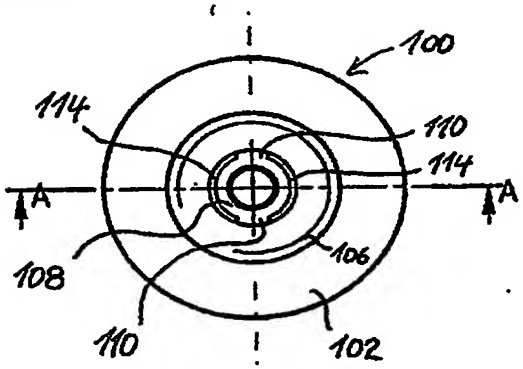

Fig. 3

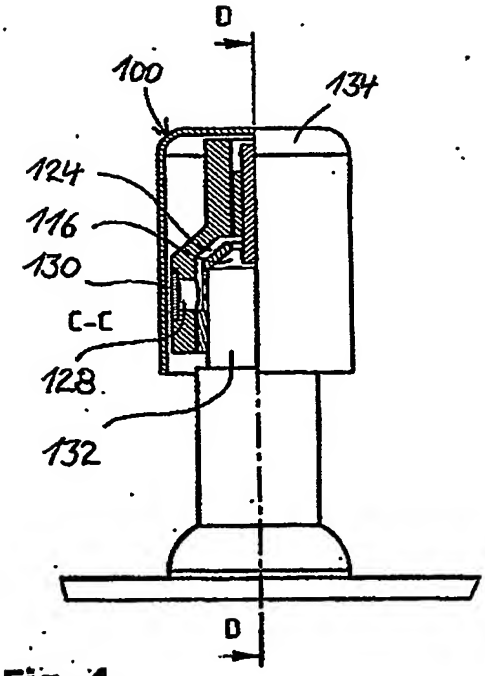

Fig. 4

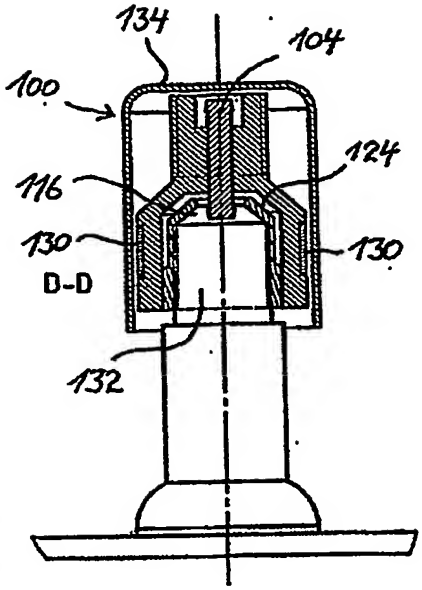

Fig. 5

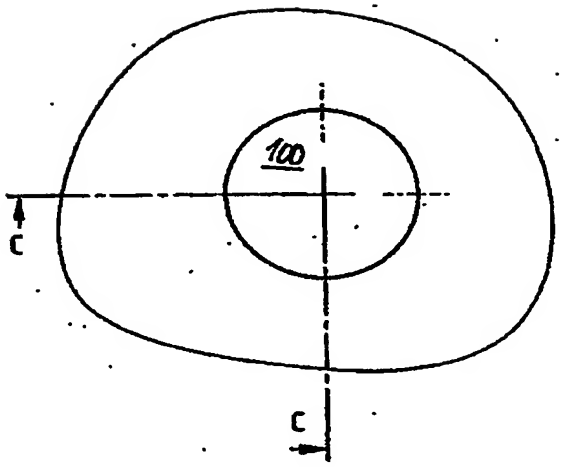

Fig. 6

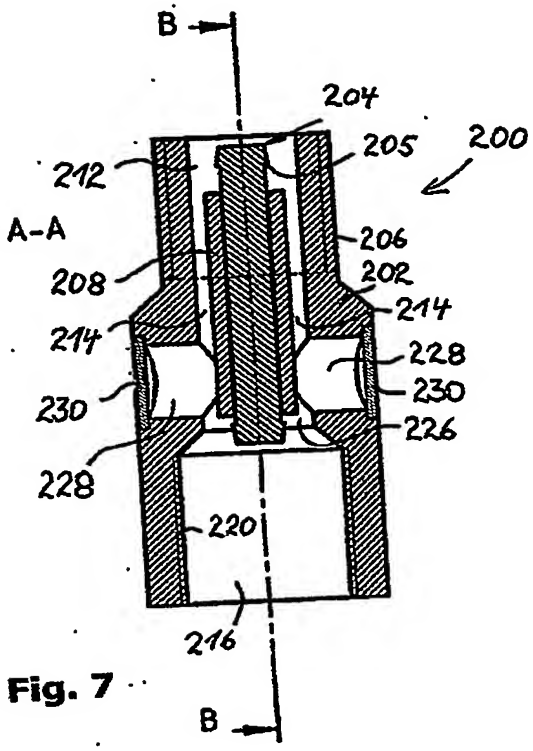

Fig. 7

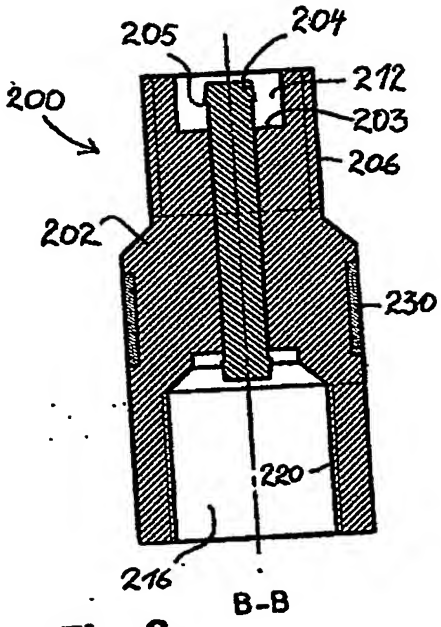

Fig. 8

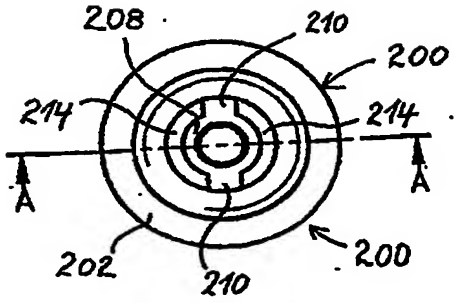

Fig. 9

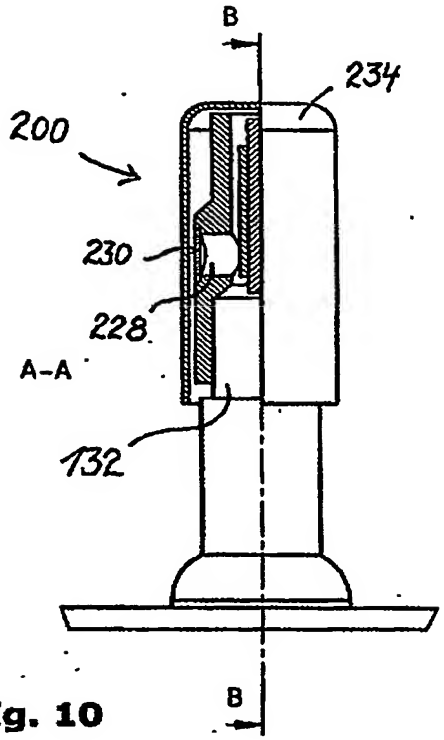

Fig. 10

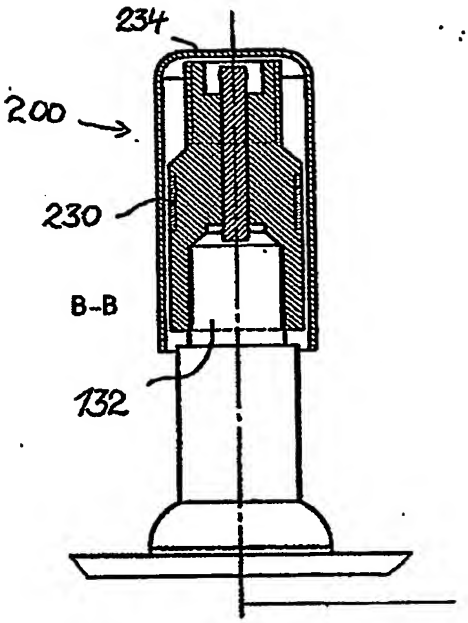

Fig. 11

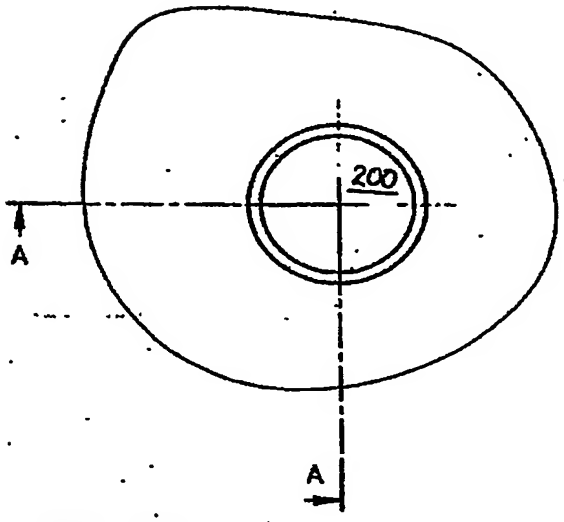

Fig. 12